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DEPARTMENT OF COMMERCE -- BUREAU OF MINES

# GEOPHYSICAL ABSTRACTS

## NO. II

BY

FREDERICK W. LEE

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Circular No. 6133.
May, 1929.

INFORMATION CIRCULAR

DEPARTMENT OF COMMERCE -- BUREAU OF MINES

# GEOPHYSICAL ABSTRACTS [1]

No. 2

Compiled by Frederick W. Lee [2]

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## 1 - GRAVITATIONAL METHODS

### THE EÖTVÖS TORSION BALANCE

Anonymous (probably Capt. H. Shaw and E. Lancaster-Jones)

Published privately by L. Oertling, Ltd., as a manual to be used with their torsion balance. London, 90 pages; undated, but late in 1925 or early in 1926.

The content of the book covers: (1) The theory of the Eötvös torsion balance; derivation of the working formulas; description of the instrument; method of observation; relation of the magnitudes observed to the lines of force and the level surfaces of gravity; corrections or normal effects, near and distance terrane; subterranean effects; effects due to certain mathematical bodies. (2) Notes on the practical employment of the Eötvös torsion balance; initial testing of the instrument and of accessories; hints on planning the survey; work at the station site; office computation and plotting of results; the interpretation of the results. (3) A description of the instrument and instructions for its manipulation.

This book was the best discussion in English on the theory and use of the Eötvos torsion balance and is surpassed only by a later paper by the same authors that covers much of the same ground. The book is suitable for a textbook for beginners, and advanced students will find it of use. It should be available as a reference book in all geological libraries and in all torsion balance department offices.

The discussion is authoritative and is given as simply as it is possible to give theory that is not very simple. Formulas for the terrane correction calculated by Schweydar's method are given in terms of tenths of feet difference in elevation and may be welcome to some who desire feet throughout in the measurements. -- Donald C. Barton.

### THE EÖTVÖS TORSION BALANCE METHOD OF MAPPING GEOLOGIC STRUCTURE

By Donald C. Barton

Am. Inst. Min. Eng. Tech. Pub. No. 50, February, 1928, 51 pp., 13 figs.

An excess or deficiency of mass causes a warping of the level surfaces and of the lines of the vertical. Either type of warping gives a small horizontal component to gravity at each of the two weights of an Eötvos torsion balance. That small component in one case is proportional to the differential curvature of the level surfaces and in the other case, to horizontal gradient of gravity. The formulas for the calculation of the differential curvature and of the gradient from observations with the torsion balance are derived



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geometrically. The effects measured by the torsion balance are the vectorial sums of the effects produced by the topographic, the planetary, and the geologic irregularities of the distribution of mass. By running levels and using certain formulas, corrections can be applied to compensate the effects of topography of minor relief. A correction varying with latitude is applied to compensate the planetary effects. From a study of the residual geologic anomalies, it is possible to interpret certain features of the geology. The theoretical gradient and differential curvature profiles are given for a vertical and a 30° fault cutting formations of increasing density downward, of an infinite symmetrical structural ridge, and infinite asymmetrical structural ridge, a finite asymmetrical structural ridge. Illustrations of actual torsion balance work are given as follows: the survey which led to the discovery of the Nash salt dome, Tex., and the prediction of the limits of the dome and its verification by subsequent drilling; calculation of the extension of the cap rock on the Hoskins Mound salt dome and the subsequent verification by drilling; a profile across the Luling fault, a survey of a buried granite Ordovician ridge in Cooke County, Tex., and an analysis of a survey of the Fox oil fields, Oklahoma. The torsion balance has a distinct place and a good future in mapping geologic structure; in some situations it works brilliantly but is not a panacea for mapping geologic structure and can not replace but merely supplement geology. Although it is easy to train an observer, the interpreter must be a well trained and experienced geophysicist and geologist. The torsion balance offers usefulness in certain types of pure-science geologic problems. -- Author's abstract.

## RESULTS OF TORSION BALANCE MEASUREMENTS IN SCHLESWIG-HOLSTEIN (ERGEBNISSE VON DREHWAAGEMESSUNGEN IN SCHLESWIG-HOLSTEIN)

By Karl Jung

Ztschr. fuer Geophysik, Jahrg., 4, Heft 7/8, 1928, pp. 395-450.

A single profile was run with a torsion balance between Husum and Flensburg across the positive magnetic anomaly mapped by Reich. The gradient values show several anomalies of much lesser size than the magnetic anomaly, but the profile of $\triangle G$ shows a very rough parallelism to the profile of $\triangle Z$. Approximate determination of depths by Jung warrant the suggestion that uplifted ancient rocks are the cause of those gradient anomalies, as Devonian is known to be practically at the surface at one place on the profile, but irregularities of the topography on the Tertiary or irregularities in the diluvium may cause such gradient anomalies. The anomalies of $\triangle G$ and $\triangle Z$ are both apparently due to some deep-seated anomalous mass. -- Donald C. Barton.



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## GRAVITY SURVEYING IN GREAT BRITAIN

By F. Shaw

Am. Inst. Min. and Met. Eng. Tech. Pub. 74, 1928, 14 pp. Also in Geophysical Prospecting, 1929., Am. Inst. Min. and Met. Eng., 1929, pp. 530-543.

The intensive torsion balance work in Great Britain has been in connection with the location of usually large and irregular deposits of iron ore. The situation was complicated by the presence of 0 to 250 feet of heterogeneous glacial drift, a subdrift topography with considerable relief on limestone, and numerous faults. On account of the superficial heterogeneity seriously affecting the differential curvature, it was neglected, and only the gradient was used. A station interval of 100 and in some cases of 50 feet was used. Many details of the field practice are given. The paper unfortunately is not illustrated with any of the results of the survey. -- Donald C. Barton.

## COMPUTATION OF EÖTVÖS GRAVITY EFFECTS

By E. Lancaster-Jones

Am. Inst. Min. and Met. Eng. Tech. Pub. 75, 1928, 55 pp. Also in Geophysical Prospecting, 1929., Am. Inst. Min. and Met. Eng., 1929, pp. 505-559.

The paper summarizes practically all the known formulas for the calculation of Eötvös gravity effects. Many of the formulas are given in a mathematically pretty but very condensed notation which is rather forbidding to the uninitiated but which becomes clearer after a little study. The formulas are handled under the headings of formulas for point elements, line elements, terrane features, topographical features, cartographic features, three dimensional features bounded by plane surfaces, irregular three dimensional figures (Nikiforov's method), and change of axes.

This paper is a most useful compendium of formulas. -- Donald C. Barton.

## A CARTOGRAPHIC CORRECTION FOR THE EÖTVÖS TORSION BALANCE

By C. A. Heiland

Am. Inst. Min. and Met. Eng. Tech. Pub. 52, 1928, 17 pp. Also in Geophysical Prospecting, 1929., Am. Inst. Min. and Met. Eng., 1929, pp. 544-560.

The "cartographic correction" is the correction for the effect of the topography beyond 100 meters from the instrument. Eötvös used a simple but approximate formula; Schweydar used more rigorous formulas. The writer divides



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the terrane into zones bounded by radii and concentric circles. By assumption of certain approximations, a formula is derived which depends on certain coefficients and the square of the elevation referred to the center of gravity of the instrument as the origin. Rule-of-thumb tabular calculation forms, including the coefficients, can be set up; the squares of the elevations are entered in the proper spaces and added or subtracted and multiplied by an indicated routine. The respective calculations for $U_{xz}$, $U_{yz}$, $U_{xy}$, and $U_{\triangle}$ each require a separate form.

This is a valid method of calculating the cartographic correction. But this type of method of calculation of the correction is being superseded by graphical methods or methods making use of tables of effects rather than tables of squares. -- Donald C. Barton.

## A NEW GRAPHICAL METHOD FOR TORSION BALANCE TOPOGRAPHIC CORRECTIONS AND INTERPRETATIONS

By C. A. Heiland

Bull. Am. Assoc. Petrol. Geol., vol. 13, No. 1, Jan., 1929, pp. 39-74.

The graphical methods suggested by Numerov, Nikiforov, Jung, Lancaster-Jones, Barton, and Haalck involve approximations which the author seeks to avoid by a graphical method making use of spherical coordinates. The space around the origin is divided into 16 equal vertical sectors. The gradient and differential curvature effects of the 16 sectors are shown by six different graphs. The construction of the graphs is described. To use the graphs the topographic or structural profiles are constructed for the 16 sectors and superimposed on the respective graphs. The effects are determined by counting up mass elements of the graph and multiplying by the respective density factors. These graphs according to the author, are applicable (1) to the computation of topographic corrections and of corrections for mine openings in underground torsion balance work, (2) to computations of the influence of two and three dimensional subterranean features in torsion-balance interpretations; and (3) to computations of the influence of such structures on the magnetometer.

This method is a valid and workable one for handling extremely complicated topographic corrections in regions of rough relief. As given, the drafting of the topographic profiles will be found too tedious for most commercial surveys. But a slight modification of the method with the use of templates and contour maps will be a valid and workable one for most commercial surveys. The method is unworkably complicated for most calculations in connection with subsurface structures. -- Donald C. Barton.



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## CALCULATIONS IN THE INTERPRETATION OF OBSERVATIONS WITH THE EÖTVÖS TORSION BALANCE

By Donald C. Barton

Geophysical Prospecting, 1929, Am. Inst. Min. and Met. Eng., 1929, pp. 480-504.

Success in interpretation of the observations depends in considerable part on the knowledge gained by calculating the effects produced by known bodies or by calculating the bodies which will produce a known effect. Most of the simpler geologic structural situations may be split into horizontal rectangular prisms, and the effect of the body can be calculated by calculating the effects of each prism by the ordinary well-known algebraic formulas. Very many of the structures in which the oil geologist or geophysicist is interested have, or may be assumed to have an axis of symmetry. Calculation of the effects on such an axis of symmetry may be very greatly expedited and simplified by the use of graphic charts of a type suggested by the writer. Each chart represents the cross-sections of a series of horizontal prisms at right angles to the plane of the section. Each prism extends to equal distances on either side of the plane of the section and is so constructed that it produces an effect of 1. (2 or 5) E at the origin.

By superposition of the cross section of a body on the graph and counting of the squares under the cross section, the effect of the body at the origin is calculated. A standard series of charts can be constructed with different ratios between the length and depth of the constituent prisms. Calculations of unknown bodies have their limitations; by use of this graphic method of calculation, a series of triangles with a common apex were found, all of which produced the same gradient and differential curvature profile within the accuracy of field observations. The use of this graphical method of analysis of an unknown structure is illustrated by application to the results of Schumann's survey of the Lanzendorf Dome near Vienna. This method of graphical calculation is not adapted for the ordinary terrane calculations or for calculations of effects not on axes of symmetry. -- Author's abstract.

## THE USE OF THE TORSION BALANCE IN THE INVESTIGATION OF THE GEOLOGICAL STRUCTURE OF SOUTHWEST PERSIA

By W. F. P. McLintock and J. Phemister

Summary of the Progress of the Geological Survey of Great Britain for 1926. Appendix 2, London, 1927, pp. 168-196.

Two officers of the survey who through the invitation of the Anglo Persian Oil Co. were sent to Persia to investigate the geophysical work of the company have reported their findings in a paper which gives the results of three torsion balance traverses, the interpretation of the results and the success of the torsion balance in indicating the partially known geology, discusses



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briefly the theory of the torsion balance and the interpretation of torsion balance surveys, and gives examples of the anomalies produced by different types of geologic structures. A selected bibliography of papers on the torsion balance is appended. It is an excellent and interesting paper. -- Donald C. Barton.

## A GRAVITY SURVEY OVER THE SWYNNERTON DYKE, YARNFIELD, STAFFORDSHIRE

By W. F. McLintock and J. Phemister

The Mining Magazine, Dec., 1927, pp. 363-365.

A line of torsion balance stations was run across the supposed prolongation of a basalt dike, where the dike was supposed to be covered with glacial drift. The results show the presence of the dike with the clearness of a text-book example. -- Donald C. Barton.

## THE DETERMINATION OF THE POSITION AND EXTENT OF SIMPLE BODIES BY MEANS OF THE USE OF THE GRADIENT AND DIFFERENTIAL CURVATURE VALUES

By Karl Jung

Ztschr. fuer Geophysik, Jahrg. 3, Heft 6, 1927, pp. 257-280.

Jung reports concisely the results of a mathematical study of the theory of the interpretation of the form and position and size of simple bodies from the form of their gradient and differential curvature profiles as the latter would be obtained for example by a survey with an Eötvös torsion balance. On account of the difficulty of handling the more complicated cases, the study was restricted to bodies (a) of simple cross section, - i.e., horizontal prisms with vertical or inclined front and back faces - horizontal plates with a vertical or inclined face, cylinders, spheres; (b) of infinite extent at right angles to the plane of the cross section (except for the sphere); (c) of homogeneous density in a medium of homogeneous density; (d) where the difference between the density of the body and of the surrounding medium is known. By the use of the relations of the abscissas of the points of algebraic and numeric maximum and minimum of the gradient and differential curvature, he gives formulas or graphs for the recognition of the presence of those simple forms of bodies and for the determination of their dimensions and of their depths below the surface. He gives also an example of the rough applicability and yet the danger of the use of the formulas in connection with bodies that are not infinite or approximately infinite at right angles to the plane of the section.

This most interesting paper is a most valuable contribution to the literature on the theory of the interpretation of torsion balance results. But the applicability of these many formulas will be extremely limited in practice; most geologic structures are not long enough in reference to their depth to be treated as infinite and are not simple enough to be represented by such simple



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cross sections; only a few actual structural situations can be treated as being of homogeneous density in a medium of homogeneous density; the density situation usually can be guessed only very approximately; and, in general, except for structures coming almost to the surface, the abscissas of that distance vary rapidly with a slight change in the ordinates of the value of the gradient or differential curvature near the points of numerical maximum of the gradient or the differential curvature. With the usual complication of the affects of irregularities of lesser and greater order obscuring the situation, the abacissa of the algebraic maxima and minima are extremely indefinite and intangible magnitudes in practice, and the probable error in the determination of the abscissas may be several times the significant differences indicative of the different forms of the bodies and different depths. These formulas will have a very limited applicability in a very rough qualitative determination, for example, of whether a body is half a mile thick and half a mile deep or 2 miles deep and 2 miles thick, but in general will not give accurate enough results to be of practical use. The paper is one which should be studied by students of interpretation but which should be used with great caution in practice. -- Donald C. Barton.

## GRAVITY SURVEYING IN GREAT BRITAIN

By H. Shaw

Am. Inst. Min. and Met. Eng., Tech. Pub. 74. Also Geophysical Prospecting, 1939. Am. Inst. Min. and Met. Eng., pp. 530-531.

Shaw gives a brief account of the field operations with the Eötvös torsion balance and the problems of interpreting the results in Great Britain. In that country, the balance is used almost entirely to locate ore deposits. These ore deposits are very small in size and many stations have to be taken from 50 to 100 feet apart in order to differentiate the effect of the ore from the effects of small faults, terrane, topography, overburden, and limestone rock Since the ores are usually located in country where the surface is fairly irregular, great care must be taken in calculating the gravitational effects of the terrane and topography as accurately as possible. When these corrections are made, an isogam map is constructed and from it the effect of the ore deposits can be fairly well distinguished from the effect of the subsurface structure and its dimentions can be calculated with an accuracy sufficient to justify the survey. To calculate effects of these various disturbing elements, it is necessary to know the specific gravity of each.

The gradient is more valuable than the differential curvature in the search for small deposits, because it is not affected by the topographic irregularities as greatly, and therefore can be calculated more accurately with the same amount of work. -- Elizabeth Buhler.



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## EXPERIMENTS WITH E. T. B. IN THE TRI-STATE ZINC AND LEAD DISTRICT

By P. W. George

Am. Inst. Min. and Met. Eng. Tech. Pub. 65, 1928, 9 pp. Also Geophysical Prospecting 1929. Am. Inst. Min. and Met. Eng., 1929.

In his brief paper, George gives a detailed account of the gravitational results around Duenweg, the Federal Brewster lease, West Picher, and the western part of the Federal Jarrett lease. He gives four cross sections and several tables showing the drilling discoveries; also two gradient maps, one near Picher and another on the Jarrett lease. From these results, George concludes that under favorable conditions, which he lists, a torsion balance survey in the Tri-State district is very helpful in outlining the silicified and fractured areas, around the edges of which the richest ore bodies are found. -- Elizabeth Buhler.

## A GRAVITATIONAL SURVEY OVER THE BURIED KELVIN VALLEY AT DRUMRY, NEAR GLASGOW

By W. F. P. McLintock and J. Phemister

Trans. Roy. Soc. Edinburgh, vol. 56, No. 7, Pt. 1, 1928, pp. 141-155.

With an Eötvös torsion balance the mass of rock south of Drumry was mapped and calculated to have a slope of $10^{\circ}$ on the east side, changing to a slope of $2\frac{1}{2}^{\circ}$ moving westward, at depths corresponding to well data. From both the gravitational map and the well data, a known buried channel was outlined to run north-south on the east side of Drumry with a sharp turn to the east at about 2,000 feet north of Drumry.

In making this survey, use was made of Schweydar's method of calculating the terrane effects by the more accurate method of considering the $Z^2$ terms as well as the Z terms; and of Lancaster-Jones' method of evaluating topographic effects from a topographic contour map.

In calculating the types of structures causing such gradients, the various common formulas are applied. For a first rough approximation to the slope and depth of the structure application was made of Eötvös' formula using isogam intervals. A detailed description is given of Mekel's scheme of combining the derivitives of $U_{xz}$ and $U_{\triangle}$ with respect to $\underline{x}$ with the observed gradient and curvature profiles, to solve for the depth, slope, and thickness, of the inclined edge of a horizontal plate infinite in three directions. -- Elizabeth Buhler.



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# THE NEW TYPE OF GRAVIOMETRIC VARIOMETER WITH SHORT PERIODS

By P. M. Nikiforov

Bull. Inst. pract. Geophys., vol. 3, Leningrad, 1927, pp. 308-316.

The large amount of time required for taking readings with the common types of torsion balances and the difficulties in transporting the instruments and outfit are a great disadvantage in their use. Besides, the Russians have repeatedly objected to the use of photographic registrations (Bull. Inst. pr. Geophys., vol. 1, Nikiforov; and vol. 2, Ghirin) and claim they can bring a number of data which show without doubt that readings taken in this manner can not be trusted.

Therefore, a new instrument was designed which is based on a slightly changed principle. This instrument also has the suspending wire, the balance beams, and the hanging weights, but it is not necessary to wait until the beams come to a rest. The position of the equilibrium is rather obtained by measuring the coordinates of the curve resulting from the movements of the beam itself. It then is sufficient to measure only two ordinates; and by not waiting until the beams have come to a rest much time is saved.

The suspending wire can be considerably shortened, and in the new Russian instrument a wire about 2 centimeters long is used. Nevertheless the sensitivity of the instrument is claimed to be about the same as that of the former types; namely, $2 \times 10^{-9}$ cgs, which is entirely sufficient.

The readings are taken visually, and special care is taken to avoid influences that might come from the body of the observer. The moving of the instrument into another azimuth is made manually; no clock work is employed. To protect the beams against hard knocks a special device was designed. No tent is required except a small and light protecting one in bad weather. The instrument can be easily carried by one man which facilitates the moving to other stations. It is set up upon a tripod instead of a special foot.

The mathematical theory of the instrument was given in a previous paper. The present article contains only a brief description of the instrument. At its end the advantages are summarized, the most important ones of which are as follows: Observation time is considerably shortened, and, therefore, more stations can be perfected per day (20 stations per day and instrument); transportation of instrument is very easy; the short torsion wire is not only much safer against breaks, but also allows the selection of a more uniform and perfect segment; the influences of temperature can be disregarded because of the short observation time; no automatic accessories are employed, and therefore all troubles which may be created by them are avoided; the taking of visual readings also eliminates all trouble with photographic plates; no helpers are needed for carrying accessories, etc.



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The new instrument seems to be a remarkable improvement on torsion balances. If the claims against damping and photographic registration are correct, then also the results should be more accurate. Besides, the considerable improvement in speed and transportability of the instrument is quite remarkable. -- E. U. von Buelow.

## THE PHYSICAL PRINCIPLES OF THE GRAVITATIONAL METHOD OF PROSPECTING

By P. Nikiforov

Bull. Inst. Pract. Geophys., No. 1, Leningrad, 1925, pp. 153-259;
No. 2, Leningrad, 1926, pp. 232-264.

A very detailed description, illustrated by many diagrams and tables, is given of the physical principles of the gravitational method of prospecting.

The contents of the work are: Chapter I, Description and theory of the torsion balance. Potential of gravity: (1) Application of the principle of the torsion balance for the determination of the elements of the gravitational field; (2) description of a torsion balance (Eötvös and that constructed in the Physico-Mathematic Institute of the Russian Academy of Sciences); (3) forces acting on the instrument; (4) differential equation of the proper movement; (5) the general integral of the equation; (6) the determination of the state of equilibrium of the torsion balance; (7) an example; (8) determination of the second derivatives of the potential of gravity by means of a graviometric variometer; (9) an example; (10) determination of constants; (11) an example.

Chapter 2, Geodetic and physical meaning of the second derivatives of the potential of gravity. Normal values, local effects and perturbations. (1) Some properties of the potential of gravity; (2) gradients of gravity along the horizontal coordinate axes; (3) changes of g; (4) the deviation of the level surface from the spheric form and the azimuths of the principal normal sections; (5) normal values, local effects, and perturbations of the second derivatives of the potential of gravity; (6) normal values (tables with values for latitudes of from 40° to 65°); (7) general expressions for perturbations of the second derivatives; (8) local effects, Eötvös formulas; (9-15) Nikiforov's formulas for the calculation of local effects; (16) cartographic effects; (17) Belov's grapho-analytical method of calculating local effects.

Chapter 3, Interpretation of the results of observations. Case of bodies of regular geometric form. Direct and inverse problem of geophysics. (1) The problem; (2) the case of a homogeneous sphere; (3) the case of a homogeneous circular cylinder; (4) the case of a horizontal layer; (5) sensitiveness of the method; (6) the case of an infinitely long horizontal layer of a rectangular shape; (7-8) the case of an inclined layer; (9) a system of parallel, inclined layers of various density; (10) the direct and inverse problem of geophysics.



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Chapter 4, The interpretation of the results of observations on the basis of the values of the gradients of the horizontal components of attraction. (1) The case of a homogeneous sphere; (2) the case of a homogeneous circular cylinder lying horizontally; (3) the case of an infinitely long horizontal layer of a rectangular shape; (4) a system of parallel, inclined layers of various density.

Chapter 5, The determination of local effects and perturbances using the Hutton-Hayford's graphical method. (1) The application of the method; (2) the determination of the local and cartographic influences; (3) the determination of the influence of the subterranean masses. -- Ayvazoglou.

## A SIMPLIFIED METHOD OF THE CALCULATION OF THE ZERO POINT OF A TORSION BALANCE

By P. Nikiforov

Bull. Inst. Pract. Geophys., No. 2, Leningrad, 1926, pp. 203-231.

A method based on the general formulas of the damping of the oscillating movements of a gravitational variometer is described. Elaboration of observations made on a large scale with the gravitational variometer has proved that V (damping coefficient) depends on the resistance of the air and the elastic property of the torsion filament and remains constant not only for the same series of oscillations in a given azimuth of the beam but also for all series of oscillations in different azimuths. Supposing V constant, simplified equations for V, $A_k$ (successive amplitudes of the curve) and $Y_o$ (ordinate by which the state of equilibrium is characterized) are derived.

An example for calculations of $Y_o$ for one series of oscillations based on the measured values of $Z_k$ (ordinates of successive maxima and minima of the curve) is given.

If the value of V for a given instrument changes in the course of time, this can be noticed immediately by the fact that the individual values of $Y_o$ do not remain constant in the given series of oscillations, but decline consequently from the mean value.

The necessary change of V for obtaining correct results may be determined easily.

For calculations according to this method, tables for the values of $A_k$, for changes of $\Delta Z = Z_k - Z_{k+1}$ and V are arranged by Prof. A. V. Terentiev and added to this article. -- W. Ayvazoglou.



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## A METHOD OF RAPID CALCULATION OF THE VECTORS OF THE EÖTVÖS DIFFERENTIAL CURVATURE IN THE CASE OF A SLOPING STRATUM

By K. A. Kirillov

Bull. Inst. Pract. Geophys., No. 2, Leningrad, 1926, pp. 265-269.

Tables and graphs are given from which the values of the vectors of the Eötvös differential curvature in the case of a sloping stratum may be calculated. The article is written with reference to Nikiforov's work, "The Physical Principles of the Gravitational Method of Prospecting." -- W. Ayvazoglou.

## THE GREATEST POSSIBLE DEVIATION OF THE INTENSITY OF GRAVITY AND THE DENSITY OF THE CLOSE-MESHED NET OF PENDULUM STATIONS

By Karl Jung

Ztschr. fuer Geophysik, Jahrg. 3, Heft 4, 1927, pp. 137-157.

The fact that the pendulum measurements performed by Berroth above the salt bed in Oldan-Hambühren have proved the possibility of an accurate prospecting of the terrane by means of a close-meshed net of pendulum stations induced the author to give a mathematical solution of this question.

The disposition of the work in the article:

A. The problem. B. Theoretical investigations: (1) Definition and simplified assumptions; (2) mathematical disposition, definition of the variation problem; (3) solution of the variation problem; (4) remarks on the elimination of some simplified assumptions. C. Numerical considerations with regard to their practical application: (1) The greatest possible deviation of the intensity of gravity; (2) the density of the close-meshed net of pendulum stations; (3) justification of the most essential simplified assumptions; (4) examples.

The calculations are illustrated by seven diagrams. -- W. Ayvazoglou.

## THE DEPENDENCE OF THE GRAVITATIONAL EFFECT ON THE INTERMEDIATE LAYERS

By T. Schlomka

Ztschr. fuer Geophysik, Jahrg. 3, Heft 8, 1927, pp. 397-400.

The author tries to establish by experiments the existence of the "Refraction of the gravitational lines of forces," as most of the previous theoretical and experimental researches on the dependence of the gravitational effect on the intermediate layers were based on the "absorption of this effect." The arrangement of the experiment (shown in a diagram) and the procedure for it



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is explained. For effectuating the gravitation, the author used an iron block of about 1,200 kilograms; the intermediate layer was water (about 825 liters) filling a sheet-iron box of the shape of an isosceles triangle (base = 100 centimeters, opposite angle 37.5°, height 112 centimeters). Measurements were performed by the Eötvös torsion balance and a table of data obtained by a series of experiments is given. Although very accurate absolute values of the effect could not be obtained, the existence of the refraction was confirmed. The author expects to take up the experiments again as soon as all precautions necessary for obtaining accurate data are accomplished. — Ayvazoglou.

## ILLUSTRATION OF THE PERIODS OBSERVED, AS WELL AS OF THEIR ACCURACY
(With 9 diagrams)

By J. Bartels

Ztschr. fuer Geophysik, Jahrg. 3, Heft 8, 1927, pp. 389-397.

The author proposes for the illustration and comparison of geophysical periods of equal length a simple form of vector diagram by which the amplitude as well as the occurrence of the maximum is shown. Several examples by which the utilization of this "period watch" is shown are discussed in the article and formulas for the estimation of errors in periods observed derived. The graphic representation of the accuracy is made by using the limits of the error obtained by calculations. The contents of the article are arranged as follows: (1) The reason why the use of the period watch shall be preferred to other methods; (2) calculations concerning the arrangement of the period watch; (3) examples given with regard to observations made in different places; (4) determination of errors; (5) relation to periodograms; (6) application illustrated by further examples and diagrams. — W. Ayvazoglou.

## A GRADUATED PLATE (PALLET) FOR MEASURING THE ZERO POINT POSITION OF A TORSION BALANCE

By S. Ghirin

Bull. Inst. Pract. Geophys., No. 3, Leningrad, 1927, pp. 317-322.

The determination of the zero-point position in the gravitation variometer with uninterrupted registering of the oscillation of the scale-beam requires computation. The present article offers a method of determination of the required equilibrated position of the scale-beam by means of a special plate (pallet) excluding the necessity of any calculation.

The construction of the graduated plate is carried out according to mathematical calculations obtained from the equation of the oscillations of the scale-beam as they die away. Both branches of the curve are laid out on a glass



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plate on which a graduated scale is set. A figure given in the article shows the pallet and the superposed curves of registration given by the apparatus. Checking by means of the graduated plate of the accuracy of reading as compared with other methods has given favorable results. -- W. Ayvazoglou.

## 2 - MAGNETIC METHODS

### ARKANSAS MAGNETOMETER STUDY RESULTS: INSPECTION OF PLATES SHOWS SEVERAL PRONOUNCED HIGHS AND LOWS, FAVORABLE AREAS FOR GAS AND OIL SEARCH

By L. Spraragen

Oil and Gas Jour., vol. 27, No. 36, Jan. 24, 1929, pp. 30, 95; vol. 27, No. 39, Feb. 14, 1929, pp. 42, 110.

The observations of the vertical intensity of magnetism made by the United States Coast and Geodetic survey are taken as the basis of the Arkansas Magnetometer study and are corrected for latitude and longitude. Isogams are drawn, both on the corrected and incorrected values. An attempt is made to show some connection between the magnetic highs and lows of those maps and the oil possibilities of the state as outlined by Branner.

Although the isogams of plate 2 are suggestive as outlining the eastern and southern edge of the Paleozoics, the net of stations is far too sparse for a study of this type to have any appreciable value for the oilman. -- Donald C. Barton.

### MAGNETOMETER STUDY OF STATE OF TEXAS, METHOD OF GEOPHYSICAL EXPLORATION BEING USED EXTENSIVELY IN WEST TEXAS, PANHANDLE, AND RED RIVER UPLIFT

By L. Spraragen

The Oil Weekly, vol. 27, No. 31, Dec. 20, 1928, pp. 25, 74-76; vol. 27, No. 33, Jan. 3, 1929, pp. 34, 76, 102.

The scattered net of observations of the vertical magnetic intensity taken by the United States Coast and Geodetic Survey, mostly at county seats, have been used as the basis of the study. The values have been corrected for latitude and longitude and isogams have been drawn both on the corrected and incorrected values. A net of cross profiles has been plotted. Conclusions are expressed in regard to the significance of some of the magnetic anomalies of the map, and the conclusion is stated that certain large features such as faults and ridges - for example, the Mexia fault - can be traced with the magnetometer.

Although a study of this type does reveal certain relations and although it is of value in the hands of an expert geologist - geophysicist - who is aware of its extremely serious limitations, it is extremely and seriously



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dangerous. The net of stations is too wide to allow the drawing of such conclusions as have been drawn; as a geologist and geophysicist, the reviewer can not accept many of these conclusions. -- Donald C. Barton.

## NEW CALIBRATING DEVICE AIDS WORK WITH THE MAGNETOMETER

By L. Spraragen

Oil and Gas Jour., vol. 27, No. 40, Feb. 21, 1929, p. 118.

A calibrated coil is used to set an electromagnetic field of controlled strength. The device consists of the calibrated coil and an instrument panel with an ammeter, potentiometer, a set of resistances, switch, and 2 dry cell batteries. The coil is so designed to fit around the magnetometer. -- Donald C. Barton.

## MAGNETIC MICROLEVELLING CARRIED OUT IN THE IRON ORE DISTRICT OF LIPETZK IN 1925

By E. Krakau, N. Malinine, and M. Penkevicz

Bull. Inst. Pract. Geophys., No. 2, Leningrad, 1926, pp. 83-95.

The authors occupied 237 stations with Brunner-Chasselon magnetic thedolites and Dover dipcircles. The tables annexed at the end of the report contain numerical data concerning the results of observation. -- Donald C. Barton.

## THE MAGNETIC OBSERVATORY IN THE COAL BASIN OF THE DON AND THE MAGNETIC SURVEY NEAR MAKEYEVKA

By J. Bahurin

Bull. Inst. Pract. Geophys., No. 2, Leningrad, 1926, pp. 96-106.

The Institute of Practical Geophysics suggests the importance of a magnetic observatory in the Don coal basin for the registration of the variation of magnetic declination in connection with mine surveying and for geophysical prospecting in the southern part of the Union of Socialist Soviet Republics. -- Donald C. Barton.



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## MAGNETIC OBSERVATIONS IN THE REGION OF THE COAL FIELDS OF THE BASIN OF THE DON (DISTRICT OF THE VILLAGE OF MAKEYEVKA)

By N. Rose

Bull. Inst. Pract. Geophys., No. 2, Leningrad, 1926, pp. 107-123.

Observations were made for the purpose of selecting a suitable site for the magnetic observatory. -- Donald C. Barton.

## THE WORK OF THE INSTITUTE OF PRACTICAL GEOPHYSICS ON THE BROWN IRON ORE DEPOSITS (OF THE TULA AND LIPETZK DISTRICTS)

By J. Bahurin

Bull. Inst. Pract. Geophys., No. 2, Leningrad, 1926, pp. 65-82.

Bahurin's paper gives the results of magnetic surveys of iron ore deposits in the Tula and Lipetzk districts, with three maps. Although most of the anomalous vectors only slightly exceed the probable error of observation, a few are considerably larger and seem to correlate with the ore deposits. In one area of the Lipetzk district the anomaly in the inclination amounted to 20 feet and the anomaly of horizontal intensity amounted to 250 gamma. In the Tula district the anomaly in the inclination was 34 feet, in the horizontal intensity 180 gamma, and in the vertical intensity 500 gamma. -- Donald C. Barton.

## THE NEW MAGNETIC UNIVERSAL BALANCE

By H. Haalck

Ztschr. fuer Geophysik, Jahrg. 3, Heft 2/3, 1927, pp. 58-68.

A new instrument is described by which the local variations of the three components (declination, horizontal intensity, and vertical intensity) of the earth magnetic field may be determined in a simple and quick way with an accuracy answering that of Schmidt's field balance used for measurements of the vertical intensity.

A detailed description of the instrument, accompanied with a few schematic pictures, and a brief discussion of the theory of the instrument are given. (The detailed discussion of this theory may be found in H. Haalck's work "Ein neues erdmagnetisches Universalvariometer, Zeitschrift fuer Instrumentenkunde, 1927, Heft 1).

The procedure for the observation work: (a) Measurement of the vertical intensity; (b) measurement of the declination; (c) measurement of the horizontal intensity; (d) determination of the constants of the instrument and of the temperature coefficients; (e) observations and calculations (forms of observation and calculation schemes are given).



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According to the author one complete measurement, inclusive of the adjustment of the instrument, by an observer more or less familiar with the work, requires from 20 to 25 minutes.

The instrument has proved to be satisfactory for measurements of weak as well as strong earth magnetic variations. (The instrument is manufactured by the Exploration G. M. b. H. Berlin, Linkstrasse 25). -- W. Ayvazoglou.

## 3 - SEISMIC METHODS

### THE SEISMIC METHOD OF MAPPING GEOLOGIC STRUCTURE

By Donald C. Barton

Geophysical Prospecting, 1929. Am. Inst. Min. and Met. Eng., 1929, pp. 572-624.

The velocity of transmission of the elastic earth waves ranges from 2.0± kilometers per second in Pho. Pleistocene sediments in the Gulf Coast area to 5.0± kilometers per second in the salt. From the point of an artificial explosion at the surface, the wave front travels radially in all directions through the surrounding formations. If a formation with a higher speed of transmission of the waves is present in the subsurface, the elastic waves are (a) reflected directly back to the surface or (b) refracted along the upper surface of the formation and then re-refracted back to the surface. By observation of the time of arrival of the "surface" and reflected waves, the depth to the top of high speed formation may be calculated. By observation of the time of arrival of the "surface" and refracted waves and by construction of time-distance curves, and by proper location of stations, the speed of transmission of the waves in both formations, the depth to the top of the lower (high speed) formation, the depth of the top of that formation, and the lateral limits of that lower formation can be calculated. The mathematical formulas are developed for the case in which each formation is isotropic and homogeneous. The method may be used in reconnaissance for salt domes, in detailing salt domes, and in mapping various types of geologic structure. Crooked drill holes may be mapped by the electric types of seismographs. The seismographs used are mostly of two types; photographically recording mechanical seismographs and photographically recording electric-induction seismographs. The time of the explosion is obtained by wireless, and in reconnaissance for salt domes the distance between shot and receiver is obtained by use of the travel time of the air waves. Charges range from a few to many hundred pounds of 60 per cent dynamite, dependent on the type of work and the local conditions of terrane and wind. The shot lengths range, in general, from 500 feet to 8 miles. In reconnaissance for salt domes, "fan" shooting is used; in most of the other type of work, profile shooting is used. A seismic troop usually consists of one firing unit and three or four receiving units. The cost of seismic work ranges from $10,000 to $20,000 per month. In reconnaissance for salt domes, 150,000 to 300,000 acres per month can be covered. The results of seismic prospecting in the Gulf Coast area have been most brilliant. In comparison to 42 old known domes, 21 domes have been discovered



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by the seismograph and proved by drilling and 27 domes have been discovered and not yet tested. Oil fields have been found on six of the 21 domes. In East Texas, 11 new domes were discovered and of those five have been proved by drilling. About 30 seismograph troops are operating in United States and Mexico. -- Author's abstract.

SOUTH LOUISIANA HAS REAL FUTURE IN NEWLY FOUND DOMES

By Jack Logan

The Oil Weekly, vol. 52, No. 7, Feb. 1, 1929, p. 84.

Logan gives a brief review of the results of geophysical prospecting and subsequent drilling in southern Louisiana. Of the 80 wells being drilled, 19 are on "geophysical" domes. Of the "geophysical" domes, 3 have been proved commercially productive, 2 have a little oil, 6 have been drilled without finding oil as yet, and 19 are untested. -- Donald C. Barton.

HOME OF "GATOR" AND WATER LILY OPENED FOR OIL BY SCIENCE, "DYNAMITE BUGGY" AND PIROGUE ARE TOOLS WITH WHICH WILDCATTERS SEEK DOMES IN LOUISIANA SWAMPS

By Wallace Davis

The Oil Weekly, vol. 52, No. 27, Feb. 1, 1929, pp. 69-76.

A popular account of field practice with the seismic method in the Louisiana swamps, illustrated by many interesting photographs of characteristic phases of the work. -- Donald C. Barton.

THE SEISMOGRAPH IN THE GULF COAST

By Mark C. Malamphy

The Oil Weekly, vol. 52, No. 5, Jan. 18, 1929, pp. 31-34.

An excellent succinct popular statement of the seismic method of prospecting for salt domes as it is actually used in the Gulf Coast. The paper is illustrated with a characteristic "shot" map and with time-distance curves. -- Donald C. Barton.



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## SEISMIC EXPERIMENTS WITH EXPLOSIONS; PRELIMINARY NOTE

By P. M. Nikiforov.

C.R.Acad.Sci.de l'U.S.S.R.,Ser.A, Leningrad, Oct., 1926, pp. 189-190.

The author briefly reports experiments carried on with various seismographs employing (1) a vertical seismograph of B. B. Galitzin, slightly changed for this special work: (2) the horizontal seismograph by Wiechert-Mintrop: (3) a small horizontal seismograph of their own design. Problems studied are defined, results obtained will be given in a separate paper at an early date. -- E. U. Von Buelow.

## 4 - ELECTRICAL METHODS

### BASIS FOR CALCULATING THE OBSERVATIONS OF EARTH CURRENTS

By A. Petrowsky

Bull. Inst. Pract. Geophys., No. 2, Leningrad, 1926, pp. 124-142.

A continuation of Petrowsky's previous paper "The Theory of Earth's Current Measurement," in which the mathematical expression was deduced for the potential in the zone surrounding a spherical electrode half sunk in the ground, and gives an analysis of that formula and a method for its application to the distribution of the field within the medium according to the deviation of a galvanometer included in the circuit between a pair of such electrodes. The observations in the fields at Ridder's mine("Electrometric Methods of Ore Prospecting and Experimental Investigation at Ridder's Mine during Summer of 1924." The abstracts of these two articles are given in Geophysical Abstracts No. 1.) confirmed the theoretical deductions. -- Donald C. Barton.

### ELECTRICAL METHODS OF PROSPECTING

By J. B. Mawdsley

British Columbia Miner, vol. 2, 1929, pp. 21-27.

The general principles underlying the self-potential, equipotential and electromagnetic methods are discussed. The cost of electrical surveying and the recent work of the Canadian Geological Survey are briefly dealt with. The paper is of a general type. -- D. A. Keys.



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# ELECTRICAL PROSPECTING BY MEANS OF ALTERNATING CURRENT
(With 8 Diagrams)

By Richard Ambronn

Gerlands Beiträge zur Geophysik, Band 19, Heft 1, 1928, pp. 5-58.

In investigations of the distribution of electric conductivity in the subsoil by means of alternating current, more particularly for the purpose of the geophysical location of minerals, salt-water horizons, and so forth, due consideration has not hitherto been given to the elliptic polarisation of the voltage, current, and magnetic field vectors, which was first recognized and used in field work by the author. The electromagnetic vectors of such a distribution of alternate currents in space describe plane ellipses of the frequency of the exciting field, the quantitative measurement and representation of which alone reproduce a complete and unambiguous picture of the whole phenomenon.

Such a complete measurement and representation of the electromagnetic field of the earth currents is possible by means of several systems of observational data. One may utilize either the plan of the ellipse, the magnitude and direction of the axes and the phase of one diameter, or one may define the plane of the vibration ellipse by means of the amplitudes and phases of three linear vibration-components not lying in a common plane.

Various combined methods are also suitable, both for practical determinations in the field and also for a clearly understandable, graphic representation of the results. The formulas for the calculation of various systems of this kind are derived in the article.

The vibration ellipse completely represents the phenomenon in time and space at any given point of observation, whilst the momentary fields, calculated for a definite and suitably chosen time - phase - give a clear view of the structure of the field at any such time.

By vectorially subtracting from the field so measured, the normal field which would have been obtained above a homogeneous subsoil, one obtains a derived, elliptically polarized field of disturbance in which the influence of the required electromagnetic anomalies in the subsoil is sharply defined. For this field of disturbance the momentary fields at suitably chosen times can also be calculated and diagrammatically represented, so that they may be individually analyzed.

On comparing this perfected process with those methods of electric investigation of the subsoil which have hitherto been used, it will be seen that heretofore only very crude determinations have been obtained, which are, in fact, usually quite erroneous physically, as the directions characterized as "lines of force" are not even lying in the plane of the true vibration ellipses. It is only by taking into account the elliptic polarization of the electromagnetic field of the earth currents that it is possible to carry out a scientifically accurate investigation of the subsoil by alternating current. -- Author's Abstract.



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## WHEN AND WHERE SHALL THE ELECTRICAL METHOD OF PROSPECTING BE USED?

By Ingemar Tennberg

Berg und Hüttenmännisches Jahrbuch, Band 76, Heft 2, Wien, 1928.

The author discusses the question why so many persons interested in exploration of ore deposits are not enthusiastic about the electrical method of prospecting, notwithstanding the fact that ore deposits have already been found by using this method. In his opinion, this distrust may be explained in the first place by the fact that the prospecting is often performed by persons and firms who do not know much about geophysics. But even in case of prospecting by substantial firms, the mine owners are often not satisfied with the results, as they expect too much.

The work of a geophysicist can not be compared with that of a bridge constructor or a surveyor of mines, as the latter two work with known qualities, whereas the solution of the problem assigned to a geophysicist depends mostly on his theoretical knowledge of the question and his personal ability.

In most cases the possibility of the solution can not be determined in advance.

The first supposition for a successful electric prospecting is that of a sufficient difference in conductivity between the ore body sought for and the bodies surrounding it. How great the ratio of conductivity shall be is at present a question discussed by the two adepts of the geophysic science, Ambronn and Koenigsberger.

The following ores are considered to be the most suitable for electric prospecting: Galena, chalcopyrites, bornite, sulphur-pyrites, magnetic pyrites, arsenic pyrites, arsenical pyrites, gray copper ore, some heavy metal sulphates, and all precious and semiprecious metals. The specific resistance of pure metals is between 100 ohms and a fraction of one ohm per cubic cm. The resistance of ore bodies lying close to the surface of the earth seldom has values smaller than 3,000 ohms per cubic centimeter. Thus a ratio of the conductivity of the rocks and that of the ore of from 1/30 upward may be adapted. A certain minimum dimension and maximum depth should also be established, as the ratio of the conductivity depends on them. According to the opinion of the author, an ore body with a ratio of at least 1/1,000, lying at a depth half as great as its length, can be determined from the surface of the earth with certainty. The minimum length of the ore body should be, according to experience, from 15 to 20 meters. In case of larger ore bodies or very small depths, the ore may be found if the ratio of conductivity is even smaller. But as the ores are mostly found disseminated in dead rocks, the determination of the ratio of conductivity is difficult, thus the possibility of solving the problem can not be decided in advance. In addition to the cardinal points such as: Ratio of conductivity, dimension, depth, and the influence of the distribution of the parts of the ore



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body, a certain importance for electrical prospecting must also be assigned to the absolute values of the conductivity of the ore bodies and rocks. In case of specific resistance of rocks smaller than from 4,000 to 5,000 ohms per cubic centimeter, complications in using the ordinary alternating current process may occur which can be overcome only with the aid of the most modern technical means, available only to the firms equipped the best. In conclusion, the author recommends the use of the geo-electrical method of prospecting, by all means, in places in which large sulphide compact ore bodies (except the pure zinc-blende) are deposited in eruptive rocks or crystalline schists. In case of sedimentary rocks exhibiting only a slight metamorphism or not metamorphic at all, the task is more difficult but may be accomplished by organizations equipped with the best scientific means. Gangue deposits must be considered unfavorable objects. Single small lenses can be discovered only if they are connected one with another so that a continuous electric conductor is formed. Only occasional results may be obtained with impregnated ores, the parts of which are bedded inside of isolating masses. As far as the preference, in connection with sensitiveness of one or the other method is concerned, the author's opinion is that a method by which the material observed may be utilized in the most logical and mathematical way should be chosen. -- W. Ayvazoglou.

## 5 - RADIOACTIVE METHODS

### ON HIGHLY PENETRATING EARTH RAYS

By L. Bogoyavlensky

Bull. Inst. Pract. Geophys., No. 2, Leningrad, 1926, pp. 184-195.

Ninety stations in the Caucasus were occupied over an area of 10,500 square meters of radium deposits in fissures in travertine. The curves of equal intensity were elongated in the same direction as the fissures. The intensity measured seemed to be constant within 3 per cent, no matter whether the observations were taken a year apart or under different meteorological conditions. At 22 of the stations the radiations were absorbed by lead screens 1 centimeter thick. The presence of radiation of greater penetrating power than the gamma rays of radium C were indicated. The effect of the radioactivity of the air was nil and of the upper soil negligible. -- Donald C. Barton.

### MEASUREMENTS OF RADIOACTIVITY AS A GEOPHYSICAL METHOD OF PROSPECTING

By Ferdinand Müller

Ztschr. fuer Geophysik, Jahrg. 3, Heft 7, 1927, pp. 330-336.

The enrichment of radioactive substances occurs under certain geological conditions. In Müller's article the steps necessary for the determination of these enrichments are described and some examples of the application given. The following problems are examined:



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A. Preparatory facts. The author mentions the literature concerning the researches and distribution of radioactive substances in minerals, rocks, waters of all kind, atmosphere, and soil. According to this distribution, there are two main kinds of problems of radioactive measurements with regard to geophysical prospecting; the first consists of discovering the active minerals and sources and of the determination of the amount and kind of the acting constituent; the second, of the solution of special geological questions in connection with the radioactive enrichment.

B. Methods of investigation: (1) Ambronn's method; (2) Bogoyavlensky's method; (3) Koenigsberger's improvement on Ambronn's method; (4) method by which the emanation content of the soil gases is determined by introduction of them into the ionization chamber by means of a pump; (5) measurements of emanation by means of fontactoscopes or fontactometers; (6) method of comparison of test pieces taken from place to place.

C. Practical examples concerning the use of one or the other method with diagrams of places in which investigations were made are given in the article. The author adds besides some observations of his own during his practical researc work on behalf of the Elbof-Piepmeyer Co. -- W. Ayvazoglou.

## RADIOMETRIC EXPLORATION OF OIL DEPOSITS

By L. N. Bogoyavlensky

Bull. Inst. Pract. Geophys., No. 3, Leningrad, 1927, pp. 113-124.

Based on the results of the study of emanations of the earth, the author performed experiments in the oil deposits of the Maikop district (Province of Kuban) in order to verify his supposition that an extremely slight change of radium content in ores influences the intensity of penetrating radiation and that the radioactivity of an oil bed must differ from that of the strata surrounding it, on the following grounds: (1) Oil, being an organic compound, possesses an immense power of absorption of radioactive emanations; and (2) the strata underlying the oil bed, having been developed from repositories of sea-ooze, are richer in radium because of the greater power of absorption peculiar to colloids. The data obtained from the experiments, illustrated by the diagrams of sections and intensities, proving the correctness of his supposition, are given in the article. -- W. Ayvazoglou.

## MEASUREMENT OF THE CONTENT OF RADIUM EMANATIONS IN THE ATMOSPHERIC AIR

By A. Lomakin

Bull. Inst. Pract. Geophys., No. 3, Leningrad, 1927, pp. 124-136.

The author describes the measurement of radium emanations in the atmospheric air, using the aspiration method, by means of blowing the tested air through a cylindrical condenser. A scheme of measurements based on theoretical



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calculations and a diagram is given. A special type of field installation arranged for this purpose is described; the construction of the apparatus is given schematically. In order to obtain the necessary intensity an automobile magneto has been used. The consumption of the air was increased up to 70 liters per second (only from 3 to 8 liters per second in previously known field installations), thus the time required for a full measurement was reduced from the usual two to three hours to 30 to 40 mimites. The records of values obtained by measurements in Leningrad and in Piatigorsk (Caucasus) are given in a table. -- W. Ayvazoglou.

## EXPERIMENTS ON RADIATIONS PENETRATING THROUGH THE CRUST OF THE EARTH

By L. N. Bogoyavlensky and A. A. Lomakin

Bull. Inst. Pract. Geophys., No. 3, Leningrad, 1927, pp. 87-111.

Disposition of the work: (1) Apparatus used; (2) place of experiments; (3) constancy of the tension of the penetrating radiation (tables showing data of observations made during three continuous years); (4) influence of the radioactivity of the atmosphere; (5) influence of cosmic radiation coming from above; (6) influence of the radioactivity of the upper stratum of the soil (diagrams and tables with data of observations at different points using hoods and filters of different thickness); (7) calculation of the coefficient of absorption with formulas and tables showing this absorption for hoods and filters; (8) calculation of the length of the wave.

The experiments were performed in Piatigorsk (Caucasus) by means of a portable electometer covered with lead 1 centimeter thick. The measurement proved that by using the same apparatus the intensity varied greatly, depending on the stations of observation. These variations of intensity were especially marked in places rich in radium, where divergences of about 100 per cent were sometimes observed between stations separated one from another by a few meters only. Measurements made at the same stations of observation during a period of three years have shown that the intensity was constant and independent of meteorological conditions. The content of radio elements in the upper layer of the soil was proved by the measurements to be constant, thus the variations were due to deeper strata only. Four hoods, fitting one into another, 2 centimeters thick each, were used for covering the apparatus from above and from the sides, and four flat lead screens (filters) were used for protecting the apparatus from beneath; the experiments have proved that the influence of the hoods was very slight only and that of the filters important, thus testifying that the electrometer was influenced chiefly from below. The coefficient of absorption was calculated by varying the thickness of the lead protecting the apparatus, from 0 centimeter to 8 centimeters. The coefficients of absorption by filters varied from 0.45 to 0.06 for 1 centimeter. In most cases the coefficient of absorption decreased with the increase of the thickness of the lead. -- W. Ayvazoglou.



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## 6 - GEOTHERMAL METHODS

By J. Joly

Gerlands Beiträge zur Geophysik, Band 19, Heft 4, Leipzig, 1928, pp. 415-441.

After a short historical introduction the following matters are dealt with: The nature and structure of the continents; the distribution of radioactivity in the earth's surface structure; the thickness of the continents as estimated on isostatic grounds; the distribution of temperature in the continents; seismic evidence as to the earth's surface structure; the probable origin of the surface structure; the thermodynamics of a revolution are specially dwelt on and a paper "On the Thermal Instability of the Earth's Crust" by H. H. Poole and J. H. J. Poole is quoted, in which the recent accessions to our knowledge of the physical properties of rocks are applied to the views of Lord Kelvin and the conclusion is reached that cyclical discharge of radioactive heat must occur.

There follows a reference to the intervention of tidal movements in the discharge of collected heat. An abstract of a mathematical paper by Cotter, "On the Escape of Heat from the Earth's Crust," is succeeded by an estimate of the rate of thermal genesis in the substratum. The stability of the ocean floor is referred to, and finally there is a note on the experimental reproduction of cyclical thermal system. -- Author's Abstract.

## 7 - UNCLASSIFIED METHODS

### AFTER DEEP DOMES WHAT?

By John F. Weinzierl

The Oil Weekly, vol. 52, No. 8, Feb. 8, 1929, p. 34.

The change in emphasis on the seismic method back to the torsion balance in the Gulf Coast area is mentioned. The opinion is expressed that a framework of detailed pendulum observations is necessary to explain the deeper tectonics. -- Donald C. Barton.

### METHODS OF APPLIED GEOPHYSICS FOR THE EXPLORATION OF OIL, ORES, AND OTHER USEFUL DEPOSITS

By Erich Pautsch

Published privately by the author, Houston, Tex., 1927, 82 pages; numerous diagrams.

In the few pages of this small book Pautsch covers: (1) The methods and tasks of applied geophysics; (2) the gravitational method, giving a brief discussion of the elements of the theory of gravitation and a more extended discussion of the theory of the Eötvös torsion balance method with some of the more



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basic formulas and profiles of the gradient and differential curvature produced by different types of bodies; (3) the seismic and acoustic methods, a discussion principally of the theoretical principles of (pure rather than applied) seimology and with an inadequate description of the instruments actually in use; (4) the magnetic method, theory and instruments; a very brief description and discussion; (5) the electric methods, a brief history of the use of electric methods and a discussion of the galvanometric method, the inductive method, the theory and description of the current in the earth method, resistance of some conducting bodies method, the (wireless) wave method, the capacity method, and the polarization method.

The discussions are so condensed and brief that the beginner will doubtfully follow and understand the discussion, and the advanced student of geophysics will not find it of much use. -- Donald C. Barton.

## ELEMENTS OF GEOPHYSICS, AS APPLIED TO EXPLORATIONS FOR MINERALS, OIL AND GAS

By Richard Ambronn (M. C. Cobb, translator)

372 pp., 84 figs., 1,672 refs. Translated from "Methoden der Angewandten Geophysik," Liesegangs Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reiche, Band 15, Theodor Steinkopf, Dresden and Leipzig, 1926. McGraw Hill Book Co., New York, 1928.

The purpose of the book is not to serve as a textbook for the execution of geophysical surveys but is, first, to provide a complete and well-balanced review of all the geophysical methods that may be used in economic geology, so that the geologist, mining engineer, layman, or executive who has to do with them or is considering the use of them, may come as completely as possible to understand their possibilities and applicabilities; and, second, to provide for the practical geophysicists and others interested in applied geophysics, reference to the thought and literature on the subject.

The book comprises an introductory chapter on the development and present position of geophysical methods in prospecting; influence of the subsurface formations on the character of the gravitational field at the surface of the earth, including pendulum and torsion-balance surveys; magnetic methods of investigations; the use of radioactive and atmospheric-electric measurements for geophysical prospecting; electrical methods of prospecting in the earth's interior; and the use of temperature methods in applied geophysics.

Under each subject the elements of the pure as well as the applied theory are given, the geophysical instruments and their method of use are described, the results of many applied geophysical surveys are shown, and practically all published descriptions of geophysical surveys are mentioned. The literature on geophysics apparently has been thoroughly searched and a detailed review is given of the pertinent thoughts, theories, suggestions, observations, data, and at the point of mention, direct references are made to the literature. There are 84 diagrams, sections, and maps and a bibliography of 1,672 articles from 277 serials.



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The portions of the manuscript checked against the original by the reviewer were found faithfully to follow the German text. Minor revision and small additions of new material were made in a few places in the book by Ambronn during the translation, but in general the book is as of the date of the original, March, 1926, and the extensive literature of 1926, 1927, and first half of 1928 is not mentioned or listed. The typography is good and the illustrations clear.

The only adverse criticism which the reviewer has to offer is that in some places not sufficient distinction is made between practically untried methods which theoretically should work and methods which have actually been proved successful. The general impression which the book gives in regard to the successful applicability of the methods in economic geology is slightly too optimistic. The book also would have been more convenient in many ways if it had been pocket-sized like the German original.

If the reviewer were allowed only one book on geophysics he would have to choose this. It will be the indispensable reference book of the professional geophysicist and the textbook of the elementary and advanced students of geophysics and of geologists, executives, and others interested in applied geophysics. — Donald C. Barton.

## APPLIED GEOPHYSICAL METHODS IN AMERICA

By Donald C. Barton

Economic Geology, vol. 22, No. 7, November, 1927, pp. 609 to 668.

The methods of applied geophysics in practical use in economic geology in America are largely foreign-born. The redeeming feature to an American is the way that they have been taken up by the American oil companies. The methods in considerable practcal use are four — the Eötvös gravimetric, the seismic, the electric, and the magnetic. The Eötvös gravimetric method was developed by Baron Eötvös of Hungary during the latter part of the past century. The seismic method was worked out by Fessenden of the United States in 1913, but in its present development is due largely to a later but independent development of the method by Mintrop of Germany. The application of electric methods to prospecting has been the subject of experimentation for nearly a century; the recent successful developments of practical instruments and technique for commercial application of the methods was by Lundberg and Nathorst in Sweden, Schlumberger in France, Gella in Austria, and Sundberg in Sweden. The magnetic method has been in practical use for over half a century in connection with magnetic iron ores. The present application of the method to faintly magnetic ores and to geologic structure dates from the recent invention by Schmidt of Berlin of his adaptation of the Lloyd balance (British) and from Schuh's mapping of the Lübteen salt dome in Germany with a Schmidt-Lloyd balance. These methods have been taken up rapidly by the American oil companies. But the recognition of the methods by schools and institutions has been much greater in Europe than in America. The record of these methods in prospecting in the Gulf Coast area has been brilliant for the torsion-balance and seismic methods. The methods, furthermore, show



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interesting potentialities for research in pure science problems of geology. The present geologic status of the methods is that the instruments and technique of observation have been developed much further than the general knowledge of the geologic interpretation of the results. Research on and with the methods is being done almost solely by commercial companies, by whom the results of the research mostly will not be released. These methods offer an interesting and almost untouched field of research to schools both of pure and applied science.--Author's Abstract.

METHODEN DER ANGEWANDTEN GEOPHYSIK (METHODS OF APPLIED GEOPHYSICS)

By Richard Ambronn

Liesegangs Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, Band 15, Theodor Steinkopf, Dresden and Leipzig, 1926, 258 p., 1,671 refs.

The purpose of the book is not to serve as a textbook for the execution of geophysical surveys, but to provide a complete and well-balanced, well-evaluated review of all the geophysical methods that may be used in economic geology so that the geologist, mining engineer, layman, or executive who has to do with them or is considering the use of them may come completely as possible to understand them, their possibilities, and their applicabilities, and to provide for the practical geophysicists and others interested in applied geophysics, the reference to all the more important literature of the subject.

The content of the book comprises an introduction giving a brief statement of the history of the development, and of the present status of the geophysical methods of exploration, and chapters on the gravimetric, magnetic, radioactivity, electric, seismic, and geothermal methods.

This book is now available in an English translation "Elements of Geophysics as Applied to Exploration for Minerals, Oil, and Gas." — Donald C. Barton.

## 8 - GEOLOGY

THE EFFECT OF GEOPHYSICAL METHODS ON DRILLING IN THE GULF COAST

By Donald C. Barton

The Oil Weekly, Houston, Tex., September 2, 1927.

The use of geophysics in connection with drilling in the Gulf Coast is another example of the replacement of haphazard methods of guess, luck, and repeated trial by moderately precise scientific methods, and marks another step in the evolution of oil production into an engineering science. The use of the geophysical methods in the Gulf Coast has shown that the torsion-balance and



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the seismograph methods afford considerable, and in some places, high precision in the location of wells in reference to the salt domes. Although as yet they have not proved practicable in the Gulf Coast, the electric methods of prospecting afford the bare possibility that ultimately they may afford considerable precision in the location of the wells in reference to the oil sands directly. The modern geophysical methods have nothingin common with the ancient but not honorable family of doodlebugs and wigglesticks which have never shown any sign of any ability to be of service to the oil operator. -- Author's Abstract.

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